B. Acronyms

ACXR	Analog Carrier
ADSL	Asymmetrical Digital Subscriber Line
AMI	Alternate Mark Inversion
ANSI	American National Standards Institute
AULSCSS	Analog Unbundled Loop Service with Customer Specified Signaling
BA	Bell Atlantic
BRI	Basic Rate ISDN
BULS	Basic Unbundled Loop Service
B8ZS	Bit Eight Zero Suppression
CAP	Carrierless Amplitude and Phase Modulation
CLEC	Certified Local Exchange Carrier
CO	Central Office
CPE	Customer Premises Equipment
CSDC	Circuit Switched Digital Capability
dB	Decibels
DDS	Digital Data Service
DLC	Digital Loop Carrier
DMT	Discrete Multi-Tone
DSX-1	Digital Signal Cross-Connect Level One
DS0	Digital Signal Level Zero
DS1	Digital Signal Level One
DVM	Data-Voice Multiplexer
HDSL	High-Bit-Rate Digital Subscriber Line
ISDN	Integrated Services Digital Network
LADC	Local Area Data Channel
LAN	Local Area Network
NEXT	Near End Cross Talk
NID	Network Interface Device
PBX	Private Branch Exchange
POT	Point of Termination
POTS	Plain Ordinary Telephone Service
PSD	Power Spectral Density
PSDS	Public Switched Digital Service
QAM	Quadrature Amplitude Modulation
RADSL	Rate-Adaptive Digital Subscriber Line
RDP	Rate Demarcation Point
SW56	Switched 56
ULS	Unbundled Loop Service
VG	Voice Grade
2B1Q	Two-Bit One-Quaternary
2WDA	2-Wire Digital ADSL-Qualified Loop
2WDA-C	2-Wire Digital ADSL-Qualified - Carrier Serving Area Loop
2WDA-R	2-Wire Digital ADSL-Qualified - Revised Resistance Design Loop
2WDH	2-Wire Digital HDSL-Qualified Loop
2WDI	2-Wire Digital ISDN-Qualified Loop
2WD56	2-Wire Digital 56 kbps DDS Loop
4WDH	4-Wire Digital HDSL-Qualified Loop
4WD1.5	4-Wire Digital DS1 Loop

10. Bibliography

The documents listed below are subject to change. References reflect the most current information available at the time of printing. Readers are advised to check the status and availability of all documents.

1- ANSI T1.401-1993, American National Standard for Telecommunications - *Interface Between Carriers and Customer Installations - Analog Voicegrade Switched Access Lines Using Loop-Start and Ground-Start Signaling.* [4]

2- TR 72565, Issue 3, June 1998, Bell Atlantic Technical Reference - *Unbundled 2-Wire Analog Loop Technical Specifications.* [5]

3- Code of Federal Regulations, Title 47, FCC Rules and Regulations, Part 68, *Connection of terminal equipment to the telephone network.* Washington, DC: Federal Communications Commission. [6]

4- TR 72570, Issue 2, July 1998, Bell Atlantic Technical Reference - *Unbundled 2-Wire and 4-Wire Analog Loops with Customer Specified Signaling Technical Specifications.* [3]

5- ANSI T1.601-1998, American National Standard for Telecommunications - *ISDN - Basic Access Interface for Use on Metallic Loops for Application at the Network Side of NT, Layer 1 Specification.* [2]

6- TR 72575, Issue 2, August 1998, Bell Atlantic Technical Reference - *Unbundled Digital Loop Technical Specifications.* [3]

7- ANSI T1.403-1995, American National Standard for Telecommunications - *Network-to-Customer Installation - DS1 Metallic Interface.* [2]

8- ANSI T1.102-1993, American National Standard for Telecommunications - *Digital Hierarchy - Electrical Interfaces.* [2]

9- ANSI T1.410-1992, American National Standard for Telecommunications - *Carrier-to-Customer Metallic Interface - Digital Data at 64 kbit/s and Subrates.* [2]

10- Committee T1 - Telecommunications Report No. 28, *A Technical Report on High-Bit-Rate Digital Subscriber Lines (HDSL);* ATIS, 1992. [5]

11- Generic Requirements GR-1089-CORE, *Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment,* Issue 1 Bellcore, December 1994.[6]

12- ANSI T1.413-1998, American National Standard for Telecommunications - *Network and Customer Installation Interfaces - Asymmetric Digital Subscriber Line (ADSL) Metallic Interface.* [2]

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[4] To obtain ANSI documents, contact American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

[5] To obtain Bell Atlantic technical references, contact Bell Atlantic Document and Information Delivery Services, 1310 N. Courthouse Rd., Arlington, VA 22201. (703-974-5887)This address/tn should be included in CLEC handbook-I will make sure it is.(Thank you)

[6] Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

13- T1E1.4/98-294, draft T1 Technical Report No. XX, *A Technical Report on Single-Carrier Rate Adaptive Digital Subscriber Line (RADSL),* September 1998. [7]

14- Technical Reference TR-NPL-000336, *Metallic and Telegraph Grade Special Access Services - Transmission Parameter Limits and Interface Combinations,* Issue 1, (Bellcore, October 1987). [8]

15- Generic Requirements GR-334-CORE, *Switched Access Service: Transmission Parameter Limits and Interface Combinations,* Issue 1, (Bellcore, June 1994). [6]

16- Generic Requirements GR-335-CORE, *Voice Grade Special Access Services: Transmission Parameter Limits and Interface Combinations,* Issue 1, (Bellcore, June 1994). [6]

17- NIS S106-1, *Electronic Business Service, Network Access interface Specification, Switched network Compatibility and Performance Specification for Two Wire Connection to a Northern Telecom DMS-100 Family Switch,* (Northern Telecom, November 1988).

18- Generic Requirements GR-337-CORE, *Program Audio Special Access and Local Channel Services,* Issue 1, (Bellcore, December 1995). [6]

19- Technical Reference TR-NPL-000341, *Digital Data Special Access Service - Transmission Parameters and Interface Combinations,* Issue 2, (Bellcore, February 1993). [6]

20- ANSI TIA/EIA-596, *Network Channel Terminating Equipment for Public Switched Digital Service.* [9]

21- Bell System Technical Reference PUB 41028, *Data Communications Using Local Area Data Channels,* (AT&T, June 1979).

22- Technical Advisory TA-NWT-001210, *Generic Requirements for High-Bit-Rate Digital Subscriber Lines,* Issue 1, (Bellcore, October 1991). [6]

23- ANSI/IEEE 743-1995, *Standard Methods and Equipment for Measuring the Transmission Characteristics of Analog Voice Frequency Circuits.* [2]

24- Bellcore TM-TSY-000645, *Spectrum Management of the Loop Plant: Compatibility of CSDC and DATA-SLC,* Bellcore, 1984. [6]

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[7] Available from Committee T1 Secretariat, Suite 500, 1200 G St. NW, Washington, DC 20005.

[8] To obtain Bellcore documents, contact Bellcore Customer Service, 8 Corporate Place, PYA 3A-184, Piscataway, NJ 08854-4156.

[9] Available from Global Engineering Documents, USA and Canada (1-800-854-7179) International (303-397-7956).

Technical Reference

Unbundled Digital Loop Technical Specifications

DRAFT 9

TR 72575, Issue 2

December 1998

Document History

Issue No.	Date	Description
1	Dec 1996	First version of document released to the public.
2	August 1998	Changed terminology, added an ISDN PSD mask, changed the DS1 pattern sensitivity test criteria, and added the HDSL, ADSL, and DS3 loops.

TR 72575, Issue 2, December 1998
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Bell Atlantic Technical Reference

Unbundled Digital Loop
Technical Specifications

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Bell Atlantic Technical Reference

Unbundled Digital Loop
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1. Introduction

1.01 This technical reference provides the technical specifications associated with the Unbundled Digital Loops offered by Bell Atlantic (BA) in tariffs and contracts. All of the loops described in this document may not be available in every jurisdiction.

1.02 This technical reference has been reissued to update some of the terminology. For example, the ISDN Basic Rate Unbundled Loop Service is now known as an unbundled 2-Wire Digital ISDN-Qualified Loop and the DS1 Unbundled Loop Service is now know as an unbundled 4-Wire Digital DS1 Loop. In addition to terminology changes, this technical reference has been reissued to provide:

- A Power Spectral Density (PSD) mask for the unbundled 2-Wire Digital ISDN-Qualified Loop;
- Specifications for the unbundled 2-Wire Digital HDSL-Qualified, 4-Wire Digital HDSL-Qualified, 2-Wire Digital ADSL-Qualified, and 4-Wire Digital DS3 loops; and,
- DS1 pattern sensitivity test criteria that conforms with American National Standards.

1.03 Unbundled digital loops enable Certified Local Exchange Carriers (CLECs) that are collocated in BA Central Offices (COs) to connect to BA subscriber loops that are designed to support various digital technologies.

1.04 The following unbundled digital loops are defined:

- 2-Wire Digital - ISDN-Qualified,
- 4-Wire Digital - DS1,
- 2-Wire Digital - HDSL-Qualified,
- 4-Wire Digital - HDSL-Qualified,
- 2-Wire Digital - ADSL.-Qualified, and
- 4-Wire Digital - DS3 (NY only).

1.05 The technical specifications in this document assume that the CLEC is collocated in the same CO as the unbundled digital loop. In the future, BA may offer transport services for unbundled digital loops. In that case, the technical specifications associated with the transport service should be consulted.

2. Service Description

A. General

2.01 The description, terms and conditions, rates, regulations, and Universal Service Order Codes (USOCs) for unbundled digital loops are contained in applicable tariffs or contracts.

2.02 Unbundled digital loops are provided subject to availability on a first-come first-served basis. Special construction charges apply when appropriate facilities are not available.

2.03 Unbundled digital loops provide the CLEC with a transmission channel suitable for the transport of certain digital technologies. The channel is between the Central Office Distributing Frame (CODF) or DSX-1 termination of CLEC equipment in a BA CO and the Network Interface Device (NID) or Rate Demarcation Point (RDP) at an End User (EU) customer location.

B. Unbundled 2-Wire Digital ISDN-Qualified (2WDI) Loop

2.04 The unbundled 2WDI loop provides the CLEC with an effective 2-wire channel that is suitable for the transport of 160 kbps digital Basic Rate ISDN signals in both directions simultaneously using the 2B1Q line code described in ANSI T1.601-1992 [1].

2.05 The interface at the CLEC CODF termination is 2-wire and the interface at the EU-RDP is 2-wire. At each interface one conductor is called tip and the other conductor is called ring. The RJ11C (6-pin) or RJ49C (8-pin) connectors are the single circuit network interface jacks that are normally used at the EU-POT.

2.06 The transmission channel between the 2WDI interfaces is effective 2-wire. An effective 2-wire channel may be entirely 2-wire or it may contain a 4-wire facility portion (such as a Digital Loop Carrier) with a 2-wire metallic extension to the EU-RDP. A typical 2WDI configuration is shown in Figure 2-1.

2.07 2WDI supports full duplex 160 kbps digital Basic Rate ISDN transmission. The 160 kbps line rate supports a 16 kbps overhead channel for performance monitoring, framing, synchronization, and maintenance. In addition, the line rate supports 144 kbps of payload data which is divided into three channels, two 64 kbps "B" (Bearer) channels and one 16 kbps "D" (Data) channel.

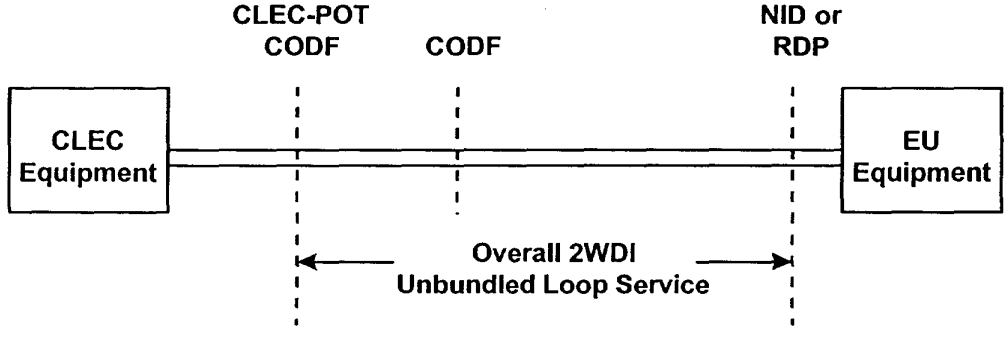

Figure 2-1. Typical 2WDI Loop Configuration

2.08 The unbundled 2WDI loop may be provided using a variety of loop transmission technologies, including but not limited to, metallic cable, metallic cable based digital loop carrier, or fiber optic-based digital loop carrier.

2.09 The unbundled 2WDI loop supports the ISDN Basic Rate Two-Binary One-Quaternary (2B1Q) line code described in ANSI T1.601-1992 [1]. Vendor-specific, non-standard line codes are not supported and the BA spectrum management guidelines for unbundled 2WDI loops do not apply to such applications.

2.10 CLEC or CPE equipment connected to a 2WDI loop shall meet the Power Spectral Density template in Figure 2-2 below. To verify compliance with this requirement, measurements shall use a noise power bandwidth of 1 kHz.

2.11 CPE that is connected to a 2WDI loop shall also meet the applicable signal power limits in Part 68 of the FCC Rules [2].

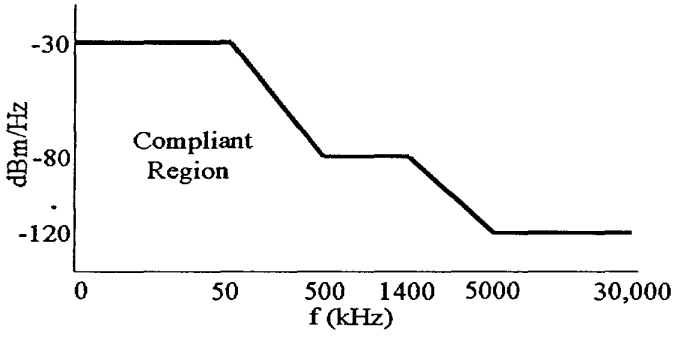

Figure 2-2. Power Spectral Density Template for Unbundled 2WDI Loop

2.12 An unbundled 2WDI loop may not be spectrally compatible in the same cable or binder group with 15 kHz Program Audio services, Type I or Type II Public Switched Digital Service (PSDS), Data-Voice Multiplexers (DVM) associated with CO-LAN services, or Analog Carrier. Additional information about spectrum compatibility may be found in Section 3E(i).

2.13 The unbundled 2WDI loop utilizes subscriber loop facilities that were originally designed for Plain Ordinary (analog) Telephone Service (POTS). For this reason, some loops, such as loaded metallic facilities or analog carrier systems, may not qualify as an unbundled 2WDI loop.

2.14 If the loop length exceeds the ISDN range, range extension may be available.

C. Unbundled 4-Wire Digital DS1 (4WD1.5) Loop

2.15 The unbundled 4WD1.5 loop provides the CLEC with a 4-wire transmission channel that is suitable for the transport of 1.544 Mbps (DS1) digital signals in both directions simultaneously.

2.16 The interface at the CLEC DSX-1 termination in the BA CO is 4-wire and the interface at the EU-NID is 4-wire. The conductors of the CLEC or EU transmit pair are called tip and ring and the conductors of the CLEC or EU receive pair are called tip 1 and ring 1. The RJ48C (8-pin) or RJ48X (8-pin with shorting bar) connectors are the single circuit network interface jacks that are normally used at the EU-POT.

2.17 The transmission channel between the 4WD1.5 interfaces consists of 4-wire facilities. An unbundled 4WD1.5 loop may be provided using a variety of loop transmission technologies, including but not limited to, metallic cable, metallic cable with a mid-span repeater, metallic cable with High-Bit-Rate Digital Subscriber

Line (HDSL) technology, or fiber optic transport systems. A typical 4WD1.5 loop configuration is shown in Figure 2-3.

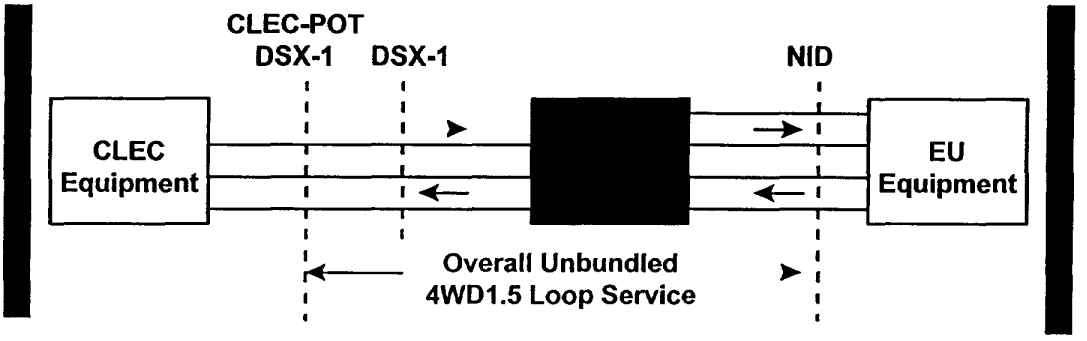

Figure 2-3. Typical Unbundled 4WD1.5 Loop Configuration

2.18 The unbundled 4WD1.5 loop enables full duplex 1.544 Mbps digital transmission. The 1.544 Mbps line rate supports an 8 kbps framing format and 1.536 Mbps of payload data. The unbundled 4WD1.5 loop will support either the Superframe (SF) or Extended Superframe (ESF) framing formats as specified in ANSI T1.403-1995 [3].

2.19 The unbundled 4WD1.5 loop is available with either the AMI or B8ZS line codes as specified in ANSI T1.403-1995 [3].

2.20 The DS1 interface provided by BA does not ordinarily deliver direct-current power to the EU-NID via the simplex leads of the transmit and receive pairs, however when BA employs metallic facilities and no loopback device is deployed, direct-current power will appear at the EU-NID on the simplex leads. In such cases, the EU equipment shall provide a direct-current connection between the simplexes of the transmit and receive pairs.

2.21 Direct-current power shall not be delivered to the EU-POT by EU customer equipment. In addition, EU customer equipment shall not apply voltages to the EU-POT other than those described in ANSI T1.403-1995 [3].

2.22 The CLEC will be responsible for providing synchronization timing for the unbundled 4WD1.5 loop.

2.23 CLEC equipment that is connected to the 4WD1.5 loop shall meet the DSX-1 signal power limits in ANSI T1.102 [4].

2.24 CPE that is connected to the 4WD1.5 loop shall meet the DS1 signal power limits in ANSI T1.403 [3] and Part 68 of the FCC Rules [2].

2.25 An unbundled 4WD1.5 loop may not be spectrally compatible in the same binder group with ADSL technologies or in the same cable with Analog Carrier. Additional information about spectrum compatibility may be found in Section 3E(ii).

2.26 Subscriber loop facilities were originally designed for POTS. For this reason, some loops may not qualify as an unbundled 4WD1.5 loop.

D. Unbundled 2-Wire and 4-Wire Digital HDSL-Qualified Loops

2.27 Two types of unbundled High-Bit-Rate Digital Subscriber Line (HDSL) loops are offered: the 2-Wire Digital HDSL-Qualified (2WDH) loop and the 4-wire Digital HDSL-Qualified (4WDH) loop. The unbundled 2WDH loop provides the CLEC with an effective 2-wire channel that may be suitable for the transport of 784 kbps digital signals simultaneously in both directions. The unbundled 4WDH loop provides the CLEC with an effective 4-wire channel that may be suitable for the transport of 1.568 Mbps digital signals simultaneously in both directions. The unbundled 2WDH and 4WDH loops are intended for the transport of 2B1Q signals as described in Committee T1 Technical Report No. 28 [5].

2.28 Unbundled 2WDH loops are currently provided by using available non-loaded metallic cable facilities. In the future unbundled 2WDH loops may be provided by using other loop transmission technologies, including but not limited to, metallic cable, metallic cable based digital loop carrier, and fiber optic-based digital loop carrier systems.

i. Unbundled 2WDH Loop

2.29 The unbundled 2WDH loop is an effective 2-wire channel that is intended to transport bi-directional full duplex 784 kbps digital signals that support up to a 768 kbps payload plus framing (8 kbps) and overhead (8 kbps). This is sometimes called single-loop operation. The actual data rate achieved on a particular 2WDH loop depends upon the performance of the CLEC-provided modems with the electrical characteristics (length, bridged tap, noise, etc.) associated with the loop.

2.30 The CLEC interface at the CODF termination for the 2WDH loop is 2-wire and the interface at the EU-POT is also 2-wire. The effective 2-wire 2WDH loop ordinarily consists entirely of 2-wire metallic facilities however in the future if Digital Loop Carrier can be used for unbundled 2WHD loops then the loop may contain a 4-wire facility portion. The RJ11C connector is the single circuit network interface jack that is used at the EU-POT. A typical unbundled 2WDH loop configuration is shown in Figure 2-5.

2.31 When metallic facilities are used to provide the unbundled 2WDH loop, the cable pair shall be non-loaded and shall meet the selected Carrier Serving Area design criteria (i.e., non-loaded, length ≤ 12 kft, etc.) in Section 3E(iii).

ii. Unbundled 4WDH Loop

2.32 The unbundled 4WDH loop is intended to transport two bi-directional full duplex 784 kbps digital signals each of which supports up to a 768 kbps payload plus framing (8 kbps) and overhead (8 kbps). This is sometimes called dual duplex or two full pair full duplex operation. The actual data rate achieved on a particular 4WDH loop depends upon the performance of the CLEC-provided modems with the electrical characteristics (length, bridged tap, noise, etc.) associated with the loop.

2.33 The CLEC CODF and EU-POT interfaces for the 4WDH loop are 4-wire. The conductors of the CLEC or EU transmit pair are called tip and ring and the conductors of the CLEC or EU receive pair are called tip 1 and ring 1. The RJ48C (8-pin) or RJ48X (8-pin with shorting bar) connectors are the single circuit network interface jacks that are normally used at the EU-POT. A typical unbundled 4WDH loop configuration is shown in Figure 2-6.

2.34 If and when digital loop carrier (DLC) is used to provide unbundled 4WDH loops, the DLC will provide two 2-wire interfaces at the CLEC-POT and EU-NID each of which meets the specifications in T1 Technical Report No. 28 [5].

2.35 When metallic facilities are used to provide the unbundled 4WDH loops, both cable pairs shall be non-loaded and shall meet the selected Carrier Serving Area design criteria (i.e., non-loaded, length ≤ 12 kft, etc.) in Section 3E(iii). In addition, each 2-wire loop may have different characteristics. The pairs may differ in wire gauge, bridged tap, and exposure to crosstalk. The difference in the transmission characteristics of each pair may change slowly due to temperature differences between each loop.

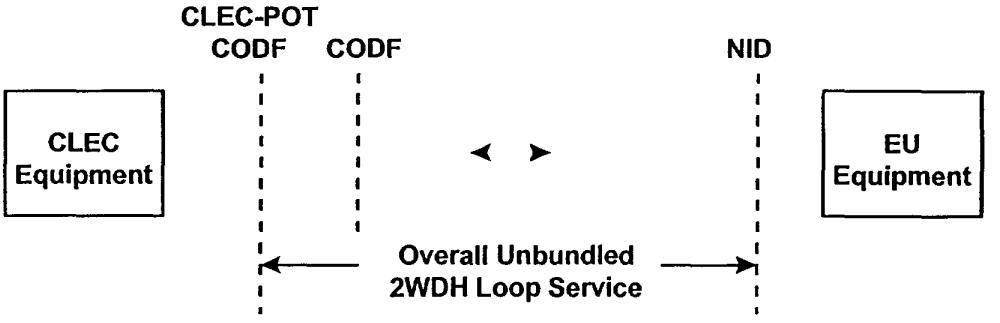

Figure 2-4. Typical Unbundled 2WDH Loop Configuration

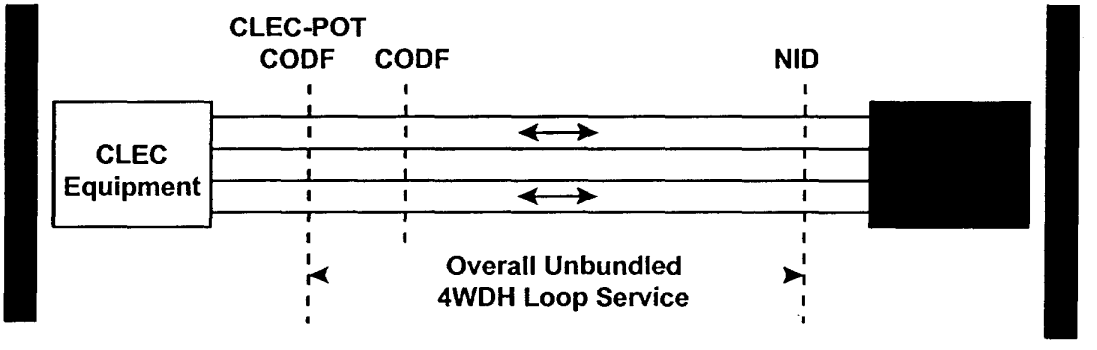

Figure 2-5: Typical Unbundled 4WDH Loop Configuration

iii. Unbundled 2WDH and 4WDH Loop Limitations

2.36 Unbundled 2WDH loops are not intended to support single-pair 1.544 Mbps full duplex HDSL systems that use a single pair and an echo canceled hybrid method to carry a 1.544 Mbps payload plus overhead in both directions simultaneously. Standards bodies refer to this as HDSL2. Bell Atlantic spectrum management guidelines for unbundled 2WDH loops do not apply to such applications.

2.37 Unbundled 4WDH loops are not intended to support Dual-Simplex (2-pair simplex) HDSL systems that use two pairs each carrying a unidirectional signal at a nominal 1.544 Mbps rate plus overhead and Bell Atlantic spectrum management guidelines for unbundled 4WDH loops do not apply to such applications.

2.38 Unbundled 2WDH and 4WDH loops may not be spectrally compatible in the same cable or binder group with 15 kHz Program Audio services, Type I or Type II Public Switched Digital Service (PSDS), Data-Voice Multiplexers (DVM) associated with CO-LAN services, or Analog Carrier. Additional information about HDSL spectral compatibility may be found in Section 3E(iii).

2.39 CLEC or CPE equipment connected to unbundled 2WDH or 4WDH loops shall meet the applicable signal power limits in T1 Technical Report No. 28 [5], Part 68 of the FCC Rules [2], and the Power Spectral Density template in Figure 2-7. The average signal power shall not exceed +15.0 dBm across 100 ohms.

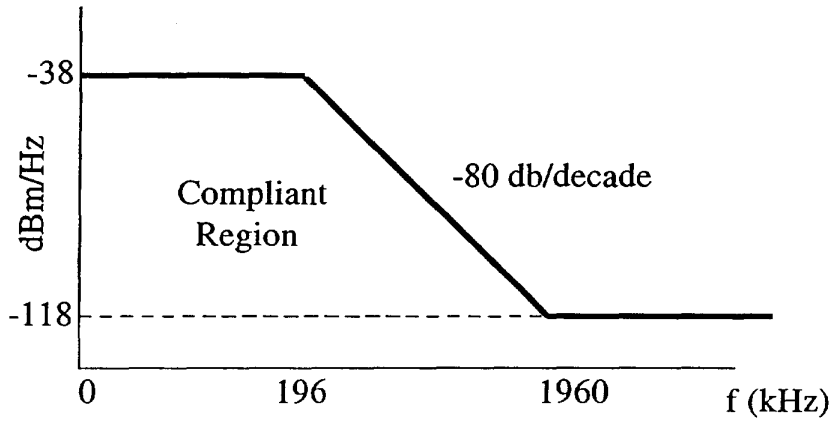

Figure 2-6. Power Spectral Density Template for Unbundled 2WDH or 4WDH Loops

2.40 Loop power or sealing current applied to an unbundled 2WDH or 4WDH loop shall not exceed the class A3 voltage limits in Bellcore GR-1089-CORE [6]. Only dc voltages that are negative with respect to ground may be used for sealing current.

2.41 Unbundled 2WDH and 4WDH loops utilize subscriber loop facilities that were originally designed for POTS. For this reason, some loops, such as loaded metallic facilities, may not qualify as unbundled 2WDH or 4WDH loops.

2.42 If the cable pair length exceeds 12 kilofeet, range extension may be available for an additional charge.

E. Unbundled 2-Wire Digital ADSL-Qualified (2WDA) Loops

2.43 Unbundled 2WDA loops provide the CLEC with an effective 2-wire channel that is intended for the transport of POTS as well as Asymmetrical Digital Subscriber Line (ADSL) signals. Two types of unbundled 2WDA loops are available: the 2WDA-R loop which is based on selected Revised Resistance Design criteria (i.e., non-loaded, length ≤ 18 kft, etc.) and the 2WDA-C loop which is based on shorter (i.e., non-loaded, length ≤ 12 kft, etc.) Revised Resistance Design criteria.

2.44 The 2WDA interface at the CODF termination is 2-wire and the interface at the EU-POT is 2-wire. One conductor of the pair is called tip and the other conductor is called ring. The RJ11C connector is the single circuit network interface jack that will be provided at the EU-POT.

2.45 Unbundled 2WDA loops are intended for the transport of ADSL DMT signals that meet the specifications of ANSI T1.413 [7] or RADSL CAP signals that meet the specifications of T1E1/97-104R2 [8].

2.46 Unbundled 2WDA loops are currently provided over 2-wire non-loaded metallic cable facilities that meet certain design criteria if such facilities are available. A typical unbundled 2WDA loop configuration is shown in Figure 2-8.

i. Unbundled 2WDA-R Loop

2.47 In addition to analog POTS signals, an unbundled 2WDA-R is suitable for the transport of Discrete Mulit-Tone (DMT) or Carrierless AM/PM (CAP) ADSL signals at different downstream (toward the EU-POT) and upstream (from the EU-POT) rates. The actual downstream and upstream data rates achieved on a

particular 2WDA-R loop depends upon the performance of the CLEC-provided modems with the electrical characteristics (length, bridged tap, noise, etc.) associated with the loop.

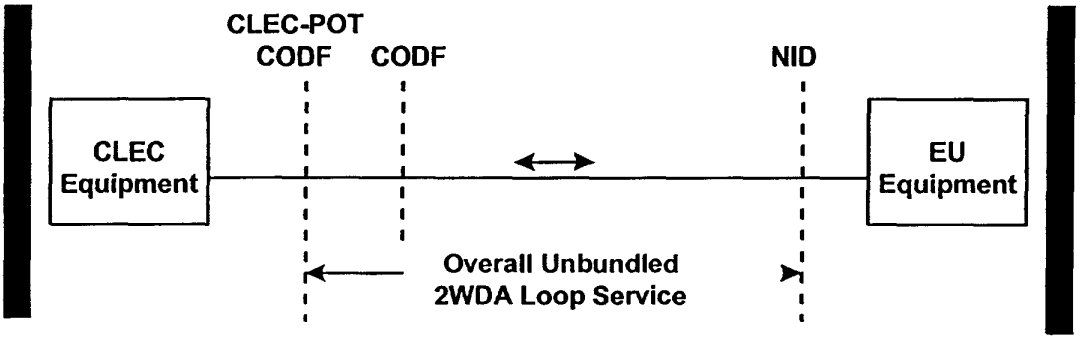

Figure 2-7. Typical Unbundled 2WDA Loop Configuration

2.48 DMT-type CPE used with an unbundled 2WDA-R loop shall meet the signal power limits in Part 68 of the FCC Rules [2], and the Upstream (from the EU-POT) Power Spectral Density (PSD) template in Figure 2-9. CAP/QAM-type CPE used with an unbundled 2WDA-R loop shall meet the signal power limits in Part 68 of the FCC Rules [2], and the Upstream (from the EU-POT) PSD template in Figure 2-10.

2.49 DMT-type CLEC equipment connecting to an unbundled 2WDA-R loop shall meet the Downstream (toward the EU-POT) Power Spectral Density (PSD) template in Figure 2-11. CAP/QAM-type CLEC equipment connecting to an unbundled 2WDA-R loop shall meet the Downstream (toward the EU-POT) PSD template in Figure 2-12.

2.50 2WDA-R loop design is described in more detail in Section 3E(iv).

2.51 The unbundled 2WDA-R loop supports loop-start signaling that meets the specifications of ANSI T1.401-1993 [9].

ii. Unbundled 2WDA-C Loop

2.52 In addition to analog POTS signals, an unbundled 2WDA-C loop may be suitable for the transport of Discrete Mulit-Tone (DMT) or Carrierless AM/PM (CAP) ADSL signals at different downstream and upstream rates. The actual downstream and upstream data rates achieved on a particular 2WDA-C loop depends upon the performance of the CLEC-provided modems with the electrical characteristics (length, bridged tap, noise, etc.) associated with the loop.

2.53 DMT-type CPE used with an unbundled 2WDA-C loop shall meet the signal power limits in Part 68 of the FCC Rules [2], and the Upstream (from the EU-POT) Power Spectral Density (PSD) template in Figure 2-9. CAP/QAM-type CPE used with an unbundled 2WDA-C loop shall meet the signal power limits in Part 68 of the FCC Rules [2], and the upstream (from the EU-POT) PSD template in Figure 2-10.

2.54 DMT-type CLEC equipment connecting to an unbundled 2WDA-C loop shall meet the Downstream (toward the EU-POT) Power Spectral Density (PSD) template in Figure 2-11. CAP/QAM-type CLEC equipment connecting to an unbundled 2WDA-C loop shall meet the Downstream (toward the EU-POT) PSD template in Figure 2-12

2.55 2WDA-C loop design is described in more detail in Section 3E(iv).

2.56 The unbundled 2WDA-C loop supports loop-start signaling that meets the specifications of ANSI T1.401-1993 [9].

iii. Unbundled 2WDA-R and 2WDA-C Loop Limitations

2.57 Unbundled 2WDA-R and 2WDA-C loops may not be spectrally compatible in the same cable or binder group with the Data-Voice Multiplexer (DVM) technology associated with CO-LAN services, Analog Carrier systems, T1 technology (including 4WD1.5), or some types of ADSL applications. Additional information about ADSL spectral compatibility may be found in Section 3E(iv).

2.58 Unbundled 2WDA-R and 2WDA-C loops utilize subscriber loop facilities that were originally designed for POTS. For this reason, some loops, such as loaded metallic facilities, may not qualify as unbundled 2WDA-R or 2WDA-C loops.

2.59 Unbundled 2WDA-R and 2WDA-C loops are not intended for applications that have spectral energy at power levels or in frequency bands that can interfere with other unbundled 2WDA-R or 2WDA-C loops in the same cable. Such interfering applications include:

- Reverse ADSL applications (i.e., End-user CPE transmits downstream frequencies and CO equipment transmits upstream frequencies);
- End-user to end-user ADSL applications (i.e., The CPE at one end transmits downstream frequencies);
- Echo canceling ADSL technology or applications that permit the upstream frequency band to overlap the downstream frequency band defined in this document; and,
- Applications that use the power boost option described in ANSI T1.413-1995 (i.e., power level exceeds the PSD templates specified in this document).

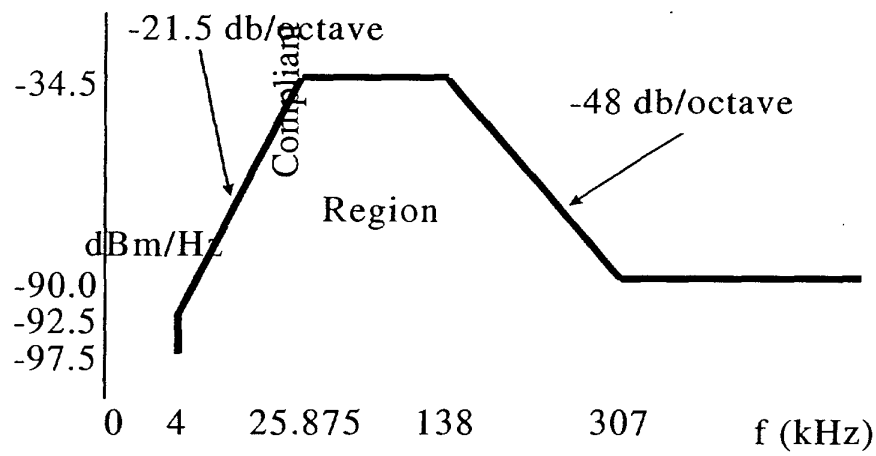

Figure 2-8. DMT Upstream PSD Template for Unbundled 2WDA Loops

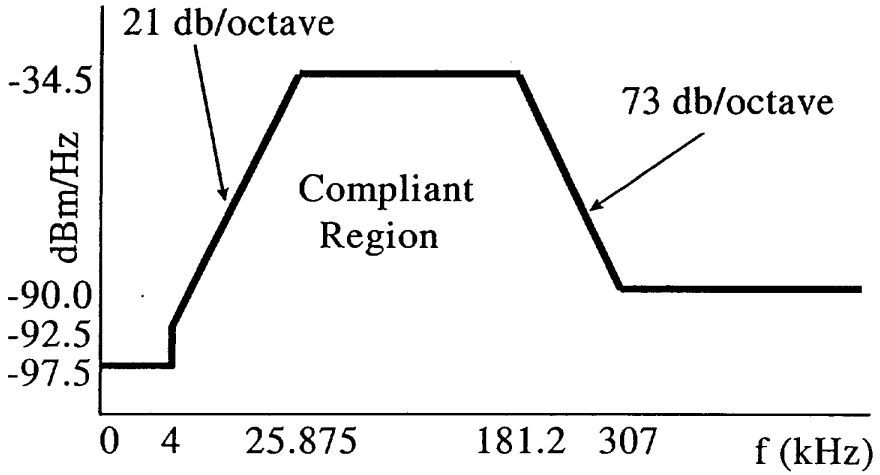

Figure 2-9. CAP/QAM Upstream PSD Template for Unbundled 2WDA Loops

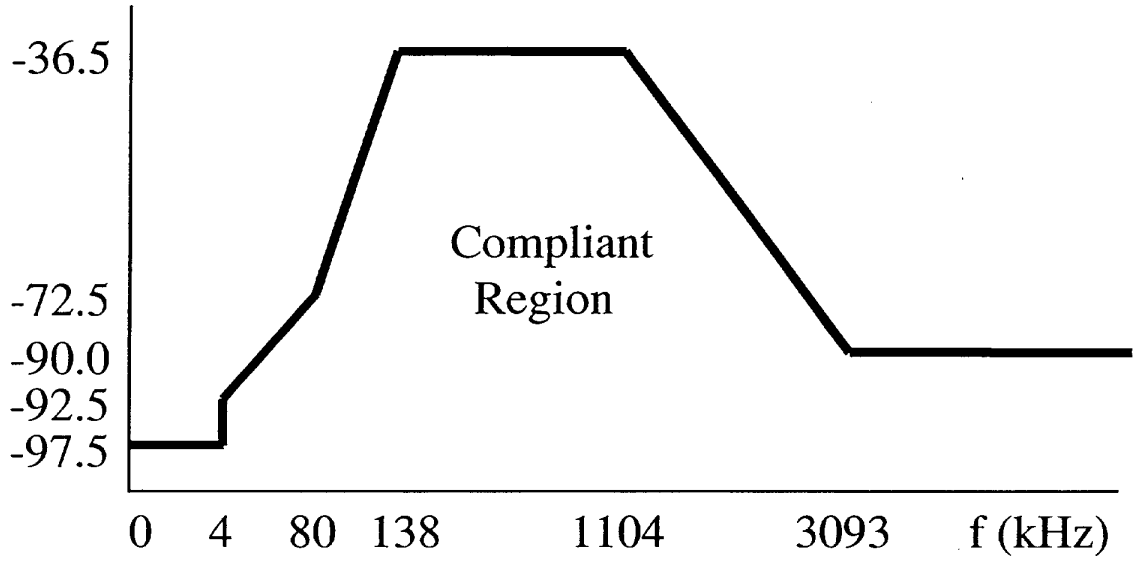

Figure 2-10. DMT Downstream PSD Template for Unbundled 2WDA Loops

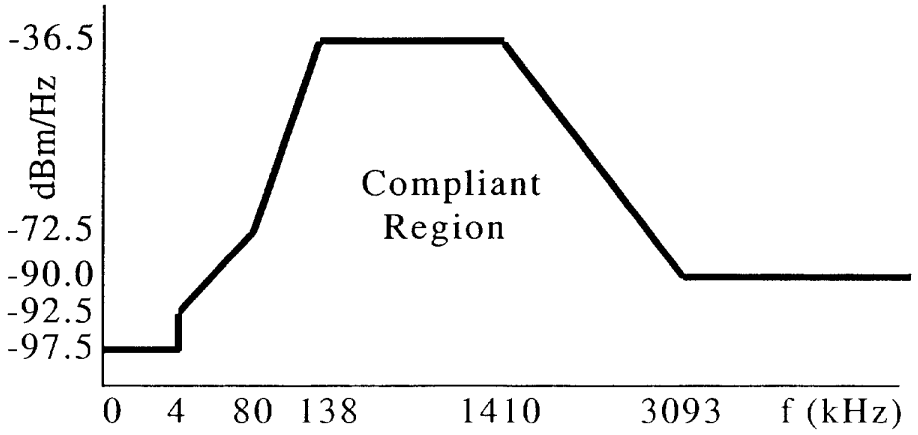

Figure 2-11. CAP/QAM Downstream PSD Template for Unbundled 2WDA Loops

F. Unbundled 4-Wire Digital DS3 (4WDS3) Loop

2.60 The unbundled 4WDS3 loop provides full duplex digital transmission at 44.736 Mbps between a CLEC that is collocated in an End Users serving CO and an EU-POT at a customer location.

2.61 The 4WDS3 loop may be provided using a variety of transport system technologies, including but not limited to, asynchronous fiber optic transport systems and Synchronous Optical NETwork (SONET) transport systems. A typical 4WDS3 loop configuration is shown in Figure 2-13.

2.62 The 4WDS3 loop interfaces the CLEC at a DSX-3 frame and the EU at a DS3 NID. The CLEC DSX-3 interface will meet the requirements in ANSI T1.102-1993 [4]. The EU-POT DS3 interface will meet the network requirements in ANSI T1.404-1994 [10].

2.63 The 4WDS3 loop uses the B3ZS line code and the M23 framing format described in ANSI T1.404-1994 [10].

2.64 The 4WDS3 loop is not synchronized by BA.

2.65 Subscriber loop facilities were originally designed for POTS. For this reason, some loops may not qualify as an unbundled 4WDS3 loop.

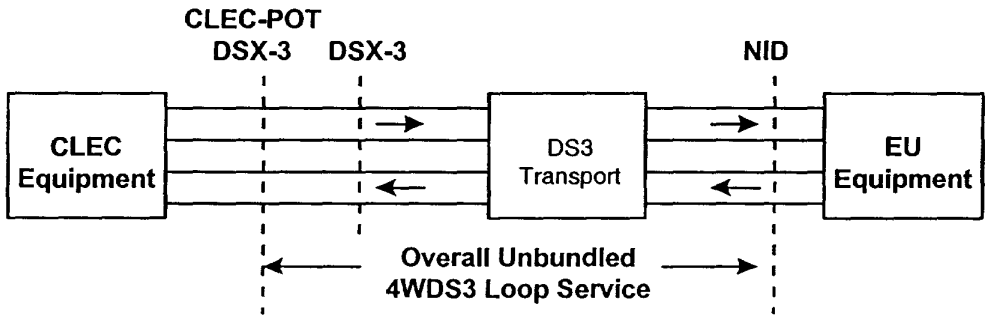

Figure 2-12. Typical Unbundled 4WDS3 Loop Configuration

3. Element Specifications

A. General

3.01 Two elements are always used with 2WDI, 2WDH, 4WDH, and 2WDA unbundled loops. They are: CODF wire and tie cable(s), and subscriber loop facilities. Figure 3-1 illustrates the service elements and identifies the sections of this document that contain the requirements for each of the elements associated with 2WDI, 2WDH, and 2WDA unbundled loops. Figure 3-2 illustrates the service elements associated with the 4WDH unbundled loop.

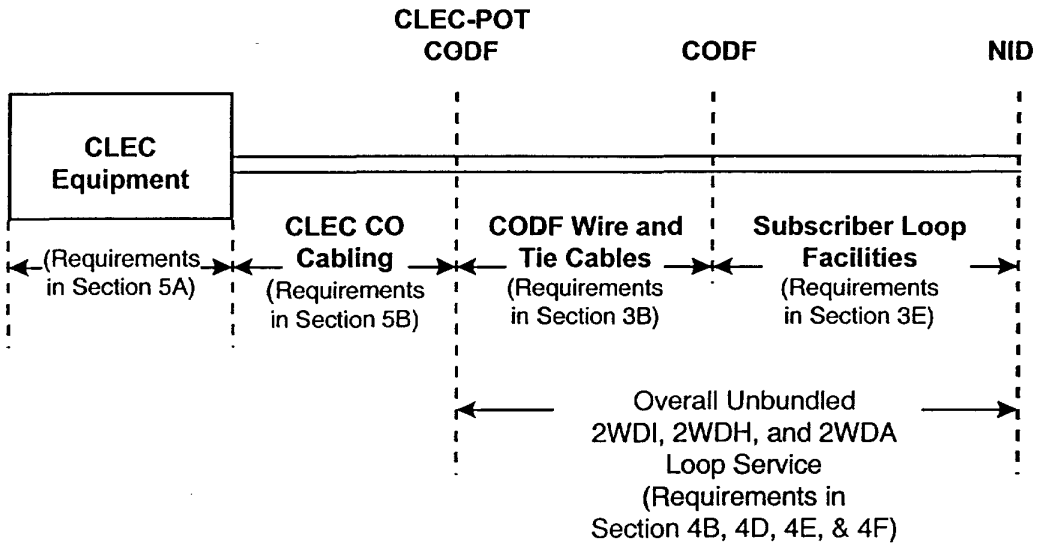

Figure 3-1. 2WDI, 2WDH, or 2WDA Service Elements

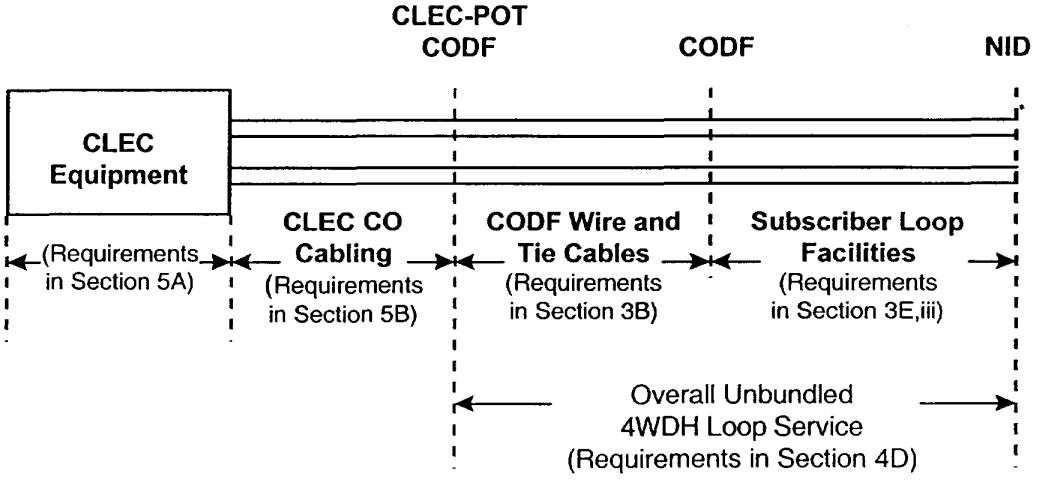

Figure 3-2. 4WDH Service Elements

3.02 A third element, electronic transmission enhancement equipment, is sometimes used with 2WDI, 2WDH, or 4WDH unbundled loops. The requirements for such transmission enhancement equipment may be found in section 3F.

3.03 Two elements are always used with 4WD1.5 loops. They are: DSX-1 cross-connect wiring and tie cable(s), and subscriber loop facilities. Figure 3-2 illustrates the 4WD1.5 service elements and identifies the sections of this document that contain the specifications for each of the elements.

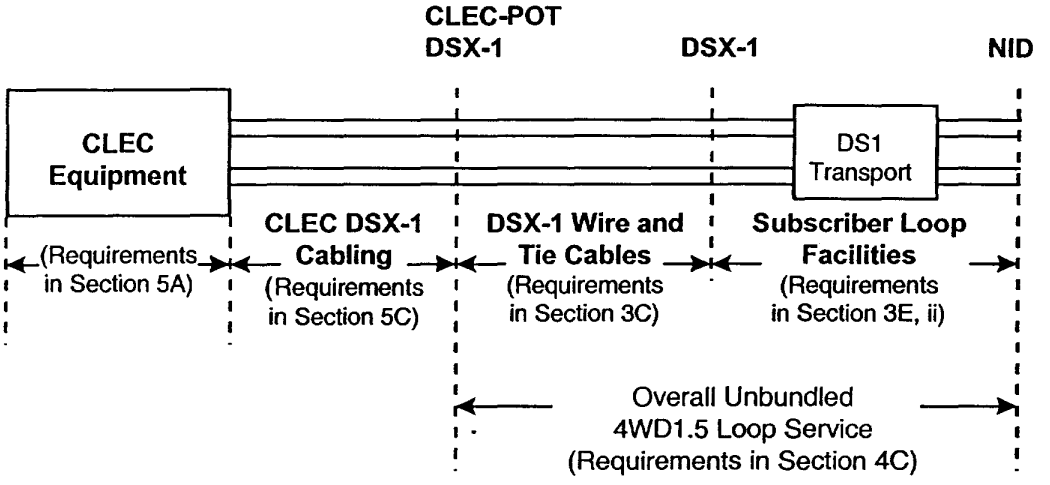

Figure 3-3. 4WD1.5 Service Elements

3.04 Two elements are always used with 4WDS3 loops. They are: DSX-3 cross-connect wiring and tie cable(s), and subscriber loop facilities. Figure 3-3 illustrates the 4WDS3 service elements and identifies the sections of this document that contain the specifications for each of the elements.

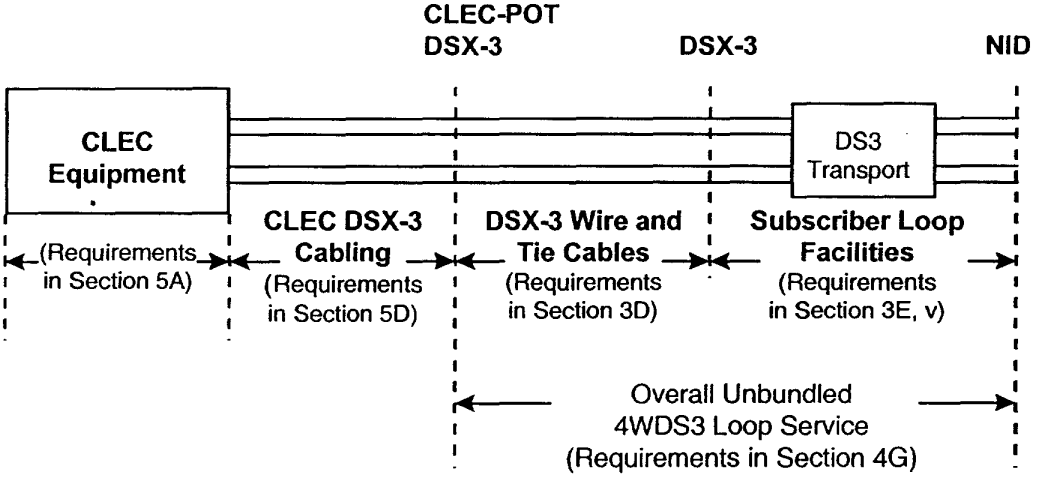

Figure 3-4. 4WDS3 Service Elements

B. CODF Wiring and Tie Cable(s)

3.05 CODF cross-connect wiring and tie cable(s) are used to link the CODF termination of collocated CLEC equipment to the CODF termination of metallic subscriber loops, DLC COTs, and electronic transmission enhancement equipment.

3.06 The total combined length of all CODF cross-connect wiring and all CODF-to-CODF tie cables between the CODF termination of the CLEC equipment and the CODF termination of any subscriber loop in the same CO should be less than 1500 feet. No bridged tap is permitted in the CO.

3.07 The direct-current resistance between the CODF termination of the CLEC equipment and the CODF termination of any subscriber loop in the same CO should be less than 80 ohms. This is equal to 1500 or less feet of 24 gauge cable.

3.08 The 1 kHz loss measured on the CODF wiring and tie cables when measured between 900 ohm impedances should be .85 dB or less.

3.09 The C-message noise measured on the wiring and tie cables between the CODF termination of the CLEC equipment and the CODF termination of a subscriber loop in the same CO shall be 20 dBrnC or less.

C. DSX-1 Wiring and Repeatered Tie Cable(s)

3.10 DSX-1 cross-connect wiring and tie cable(s) are used to link the DSX-1 termination of CLEC equipment to the DSX-1 termination of the BA DS1 subscriber loop. In some cases, an electronic digital cross-connect system may be substituted for the DSX-1.

3.11 The total length of all DSX-1 cross-connect wiring should be less than 85 feet of 22 gauge cable.

3.12 When repeatered tie cables are used to link CLEC DSX-1 terminations to BA DSX-1 terminations, the cabling between the repeaters and the DSX-1 panels shall be built-out in each direction of transmission such that the overall cabling and build-out is the equivalent of 655 feet of 22 gauge ABAM cable.

D. DSX-3 Wiring and Repeatered Tie Cable(s)

3.13 DSX-3 cross-connect wiring and tie cable(s) are used to link the DSX-3 termination of CLEC equipment to the DSX-3 termination of the BA DS3 subscriber loop. In some cases, an electronic digital cross-connect system may be substituted for the DSX-3.

3.14 The total length of all DSX-3 cross-connect wiring should be less than 27 feet of 75 ohm coaxial cable.

3.15 When repeatered tie cables are used to link CLEC DSX-3 terminations to BA DSX-3 terminations, the cabling between the repeaters and the DSX-3 panels shall be built-out in each direction of transmission such that the overall cabling and build-out is the equivalent of 450 feet of 75 ohm coaxial cable.

E. Subscriber Loop Facilities

3.16 Subscriber loop facilities consist of feeder and distribution plant between the CODF or DSX-1 and the EU customer's RDP. Feeder plant uses a variety of transmission technologies, including but not limited to, twisted-pair metallic cables, twisted-pair metallic cable based digital loop carrier, and fiber optic based digital loop carrier. Distribution plant usually consists of multipair metallic cables. Additional information about subscriber loops may be found in Bellcore SR-2275 [11].

3.17 Subscriber loop facilities have been designed on a global basis primarily to accommodate POTS and guarantee that loop transmission loss at 1 kHz is statistically distributed and that no single loop exceeds the signaling range of the CO.

3.18 Prior to 1980, loops were designed using one of the following design plans: Resistance Design, Long Route Design, or Unigauge Design. From 1980 to 1986, the Modified Resistance Design, Modified Long Route Design, and Concentrated Range Extension with Gain plans were applied on a going-forward basis (i.e., retroactive redesign was not implemented). In 1986, the Revised Resistance Design (RRD) plan was applied on a going-forward basis.

3.19 Most metallic loop facilities (98%) were designed using the RD, MRD, or RRD design rules. The RRD design rules currently in use limit the loop resistance to the design range of the CO switch (1300 or 1500 ohms) or 1500 ohms whichever is less. The vast majority of non-loaded loops, designed using these rules, are < 1300 ohms.

i. Unbundled 2WDI Loop

3.20 The unbundled 2WDI loop uses a subscriber loop facility between the BA CO and the EU-POT. The 2WDI loop is either:

(a) a qualified metallic non-loaded facility consisting of cable and wire between the CODF and the RDP wire with no intermediate electronics; or,

(b) a metallic loop facility with intermediate transmission enhancement equipment that consists of a qualified metallic non-loaded facility between the CODF and intermediate transmission enhancement equipment and a qualified metallic non-loaded facility between the intermediate transmission enhancement equipment and the RDP; or,

(c) a universal digital loop carrier (DLC) facility with 2B+1D ISDN Basic Rate transport capability via three DS0 channels. The DLC facility consists of:

- CO cabling between the CODF and a DLC Central Office Terminal (COT) equipped with an ISDN Basic Rate Interface Terminal Equipment (BRITE) channel unit with NT functionality;
- a fiber or metallic facility from the DLC COT to the DLC Remote Terminal (RT) equipped with an ISDN BRITE channel unit with LT functionality; and,
- a qualified metallic non-loaded facility consisting of cable and wire between the DLC RT and the RDP.

3.21 An ISDN-qualified metallic loop facility shall meet the following criteria which is based on selected Revised Resistance Design guidelines:

(a) The metallic cable shall be non-loaded.
(b) The total length of the cable shall be less than 18 kft.
(c) The direct current resistance measured between the CODF and the EU-RDP shall be 1300 ohms or less.
(d) Loaded bridged tap is not permitted.
(e) The total length of all bridged tap shall be less than 6 kft.
(f) The total cable length plus the bridged tap length shall not exceed 18 kft.
(g) The 40 kHz loss when measured with 135 ohm impedances at each end shall be 40.0 dB or less.

3.22 Metallic loops that have a 40 kHz loss between 40 and 76 dB will require intermediate transmission enhancement equipment such as a mid-span repeater or similar device. Bell Atlantic spectrum management rules do not permit the placement of more than one mid-span repeater per loop. If a loop will not operate with one repeater, an alternative would be the construction of DLC.

3.23 The insulation resistance between the tip conductor and ground and the ring conductor and ground on the metallic loop portion of any unbundled 2WDI loop shall each be greater than 100 K ohms.

3.24 The longitudinal noise or power influence (PI) measured per IEEE Std 743-1995 [12] on a 2WDI metallic loop should be less than 90 dBrnC.

3.25 The longitudinal balance of a metallic 2WDI loop is defined as the longitudinal noise (in dBrnC) minus the C-message noise (in dBrnC). The longitudinal balance shall be >50 dB.

3.26 An unbundled 2WDI loop will not operate properly on non-staggered twist cable (installed prior to 1923) or on flat ribbon cables, such as those used for some CPE interconnections. Such cable may need to be replaced to accommodate an unbundled 2WDI loop.

3.27 There is a potential for Basic Rate ISDN technology to interfere with 15 kHz Program Audio Service, extended range DDS technology, Type II and Type III PSDS, DVM technology associated with CO-LAN services, and analog carrier technology.

3.28 15 kHz Program Audio and unbundled 2WDI loops are spectrally compatible when they use pairs that are located in different binder groups. Pairs in non-adjacent binder groups are preferred but pairs in adjacent binder groups will usually provide adequate separation.

3.29 Extended Range DDS technology is spectrally compatible with unbundled 2WDI loops when they use pairs that are located in different binder groups.

3.30 Type II PSDS, which is also known as AT&T CSDC, is no longer available from BA. Type III PSDS, which is also known as the Nortel Datapath technology, is spectrally compatible with unbundled 2WDI loops when they use pairs that are located in different binder groups.

3.31 BA LANGATE service is a CO-LAN service that uses DVM technology. If DVMs are operated at less than 80% of the maximum specified range, they are spectrally compatible with unbundled 2WDI loops. If operated at or above the 80% range however, DVMs are spectrally compatible with unbundled 2WDI loops when they use pairs that are located in different binder groups.

3.32 Analog carrier technology is being phased out in BA. Analog Carrier systems and unbundled 2WDI loops may need to be assigned to pairs in different cables in order to prevent the unbundled 2WDI loops from interfering with the Analog Carrier technology.

ii. Unbundled 4WD1.5 Loop

3.33 An unbundled 4WD1.5 loop uses a subscriber loop facility between the CO and the EU-NID. The loop is either:

(a) a qualified metallic non-loaded facility consisting of cable and wire between the CODF and the NID wire with no intermediate electronics; or,

(b) a qualified metallic non-loaded facility consisting of cable and wire between the CODF and the NID wire with transmission enhancement equipment such as regenerators or HDSL technology; or,

(c) a fiber facility with optical multiplexing equipment at each end from the CO to a Remote Terminal (RT) location with qualified metallic non-loaded cable and wire between the DLC RT and the NID.

3.34 When an unbundled 4WD1.5 loop is provided using 4-wire facilities with HDSL electronics at each end, each pair is non-loaded and meets selected Carrier Serving Area (CSA) design criteria.

3.35 When an unbundled 4WD1.5 loop is provided using 4-wire non-loaded facilities without electronics, the facility must not have bridged tap and the length is limited to less than 3000 feet (nominal).

3.36 When an unbundled 4WD1.5 loop is provided using 4-wire T1 span facilities, the loop is designed with DS1 regenerators spaced every 6000 feet (nominal) and with nominal 3000 foot end sections toward the CO and the end-user.

3.37 There is a potential for T1 span facilities to interfere with Analog Carrier technology, ADSL technology, 2WDA loops, and some types of CO-LAN DVM technology..

3.38 T1 technology is spectrally compatible with CO-LAN DVM technology when the technologies use pairs that are located in different binder groups.

3.39 Analog Carrier systems are being phased out in BA. Analog Carrier systems and the T1 span facilities used for unbundled 4WD1.5 loops may need to be assigned to pairs in different cables to prevent 4WD1.5 unbundled loops from interfering with the Analog Carrier systems.

3.40 T1 technology and ADSL technology (including 2WDA loops) are spectrally compatible when they use pairs in different binder groups.

iii. Unbundled 2WDH and 4WDH Loops

3.41 Unbundled 2WDH and 4WDH loops use a subscriber loop facility between the CO and the EU-RDP. The subscriber loop is either a 2-wire or 4-wire metallic non-loaded facility consisting of cable and wire between the CODF and the RDP wire with no intermediate electronics.

3.42 Unbundled 2WDH and 4WDH loops shall conform to the Carrier Serving Area (CSA) design guidelines shown below. Since CSA guidelines have not been used for metallic cables connecting COs with customer locations, most metallic loops will not meet all of the strict CSA criteria.

(a) The loop shall be non-loaded.
(b) Multi-gauge loops are restricted to two gauges (excluding short cable sections used for stubbing of fusing).
(c) The total length of all bridged tap shall be $\leq$ 2.5 kft.
(d) No single bridged tap may exceed 2.0 kft.
(e) The amount of 26 gauge cable, used alone or in combination with another gauge cable, may not exceed a total length of 9 kft including bridged tap.
(f) For single gauge or multi-gauge cables containing only 19, 22, or 24 gauge cable, the total cable length plus the total bridged tap length may not exceed 12 kft.
(g) The total cable length plus total bridged tap length of a multi-gauge cable that contains 26 gauge cable may not exceed:

$$12 - \left\lceil \frac{3(L26)}{9 - LBT} \right\rceil$$

where L26 is that total length (in kilofeet) of 26 gauge cable (excluding any 26 gauge bridged tap) and LBT is the total length (in kilofeet) of all bridged tap

(h) The dc resistance of the loop measured between the CODF and the EU-NID shall be 750 ohms or less.
(i) Loaded bridged tap is not permitted.

3.43 The insulation resistance between the tip conductor and ground and the ring conductor and ground on the metallic loop portion of any 2WDH or 4WDH loop shall each be greater than 300 K ohms.